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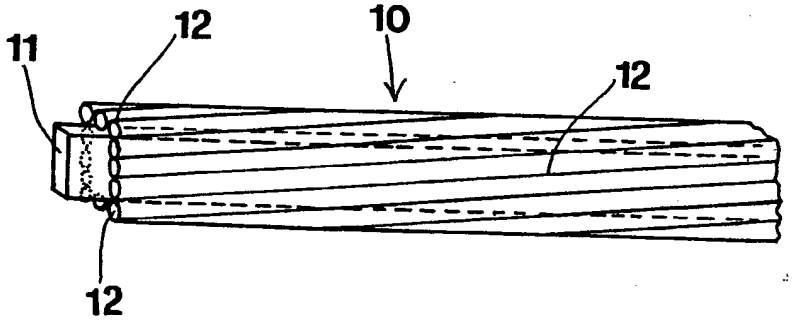
(54) Title: STRANDED CONDUCTOR OF ELECTRICITY WITH A FLAT WIRE CORE



(57) Abstract

Stranded conductor of electricity (10) made of copper, aluminium or the alloys of other conducting metals formed of a straight core (11) consisting of one or more flat wires (11, 16, 17, 18) surrounded by one or more layers of wires (12) or plied wires or flat wires, helically wound, squeezed if required to give the cross section a square or rectangular shape.

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STRANDED CONDUCTOR OF ELECTRICITY WITH A FLAT WIRE CORE

The invention concerns a stranded conductor of electricity the cross section of which is square or rectangular.

It is well known that stranded conductors are made to carry alternating current reducing the effects of eddy currents, and must be easy to place alongside one another to reduce bulk as far as possible especially in the windings of electric machines.

It is also known that when a conductor of electricity carries alternating current (alternating current only or else superimposed over a component of direct current), its cross section shows an uneven arrangement of small wires that are a cause of ohmic loss and reduce the total magnetic flow linked to the conductor itself.

Due to this latter phenomenon the inductance value of an inductor is lowered as frequency rises. The greater the dimension of the conductor perpendicular to the direction of flow, the more is this effect noticeable. For this reason conductors containing several parallel elements with suitable transpositions have been in use for some time, as have stranded conductors made up of many small elementary wires insulated one from another and of which the stranding constitutes continuous transposition. The various wires are laid symmetrically and the alternating current is split up equally among them. Eddy currents are greatly reduced inside each wire compared with those present in one big conductor whose overall cross section is the same as that of the stranded conductor.

According to present technology the stranded conductor consists of a central wire with a layer of wires wound helically round it and perhaps further concentric layers

outside the first.

The cross section of a stranded conductor so made is approximately circular.

In order therefore to reduce conductor bulk and especially to facilitate arrangement of conductors in the windings of electric machines to make better use of available space, it has been found advantageous to compress said conductors and give them a cross section that is square or tending to rectangular.

The present invention facilitates production of conductors with a square or rectangular cross section as will be explained below.

Subject of the invention is a conductor of electricity made of copper, aluminium or alloys of other conducting metals, stranded with a central straight core consisting of one or more flat wires electrically insulated, or uninsulated. Said core is surrounded by one or more layers of wires or stranded wires or flat helically wound wires.

In one execution the conductor made with the characteristics described is adequately compressed to give it a square or rectangular cross section.

Thickness of the flat wires is preferably equal to the diameter of the wires or stranded wires wound helically about them, while the width of the flat wires is practically a multiple of said diameter of the wire or stranded wires.

The flat wires forming the core are preferably of equal width and are superimposed one on the broader surface of the other.

The advantages of the invention are clear.

It is much easier thereby to obtain considerably flattened square or rectangular section conductors, ratio between

the two sides being decided as required, greatly reducing bulk and raising the filling coefficient. By arranging the conductors in the windings so that the main component of flow - axial in a circular coil - is parallel to the greater side of the flat wire, the dimension of said wire perpendicular to flow will be less, and eddy currents will be reduced to a minimum. Cooling channels can also lie parallel to the wider side of the flat wires so that conductor heat is dispersed through the lesser thickness and operating temperature can thereby be lowered.

The advantages secured by flattened cross sections are even more evident in the case of very thick conductors. Where alternating current contains components of both higher and lower frequency or components of direct current, the higher frequency currents will pass through the finer wires and the lower frequency currents through the flat wires.

Characteristics and purposes of the invention will be made even clearer by the following examples of its execution illustrated by diagrammatic figures.

Fig.1: Conductor of electricity, subject of the invention, with a flat wire core and one outer layer of wires, in perspective.

Fig.2: Cross section of the conductor in Fig. 1.

Fig.3: Conductor of electricity, subject of the invention, with three central flat wires and one outer layer of wires, in perspective.

Fig.4: Cross section of the conductor in Fig. 3.

Fig.5: Conductor of electricity, subject of the invention, with flat wire core and two outer layers of wires, in perspective.

Fig.6: Cross section of the conductor in Fig. 5.

The stranded conductor of electricity 10 comprises a core 11 in the form of a flat wire, surrounded by a layer of twelve wires 12 wound in a loose spiral (Figs. 1, 2).

The flat wire lies inside the conductor straight and does not turn on its own axis.

Thickness of said flat wire is practically equivalent to the constant diameter of the wires forming the outer layer while its width is practically equivalent to three times said diameter.

As the figures show, the cross section of the conductor is substantially rectangular.

In Figs. 3 and 4 the conductor 15 comprises a core consisting of a set of three flat wires 16, 17, 18 surrounded by a layer of sixteen wires 19 wound in a loose spiral.

This set of flat wires also lies straight inside the conductor without turning on its own axis.

Thickness of each flat wire is substantially the same as the constant diameter of the wires forming the outer layer while width of each flat wire is equivalent to the sum of the three diameters of said wires.

As the figures show, the cross section of the stranded conductor is substantially square.

Figs. 5 and 6 illustrate a stranded conductor 20 comprising a core of one flat wire 21 surrounded by a layer of wires 22 with another layer of wires 23 outside the first.

Thickness of the flat wire is practically equivalent to the constant diameter of the wires while its width is that of the sum of four of said diameters.

The cross section of this conductor is substantially rectangular.

The conductor subject of the invention has a cross section

that is clearly square or rectangular according to the shape of the core formed of one or more flat wires.

The conductor so obtained is compressed to a greater or lesser extent to raise the coefficient of filling with accentuation of its geometrically square or rectangular shape.

The conductors are laid in the windings of electric machines in such a way that the main component of flow, which in a circular coil is axial, lies parallel to the broadest side of the flat wires.

In this way the dimension perpendicular to flow, namely the thickness of the flat wire, is the lesser and effects produced by eddy currents are reduced to a minimum.

CLAIMS

1. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, characterized in that the core consists of one or more flat wires (11), (16), (17), (18), (21), the purpose being to produce a cross section that is practically square or rectangular.

2. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the flat wires (11), (16), (17), (18), (21) may or may not be electrically insulated.

3. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the core is surrounded by one or more layers of helically wound wires (12), (19), (22), (23).

4. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the core is surrounded by one or more helically wound lwyers of plied wires.

5. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the core is surrounded by one or more helically wound layers of flat wires.

6. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the core is squeezed to accentuate the square form of the cross

section and raise the coefficient of filling.

7. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the core is squeezed to accentuate the rectangular form of the cross section and raise the coefficient of filling.

8. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claims 1, 3, 4, characterized in that the thickness of each flat wire (11), (16), (17), (18), (21) is practically equal to the diameters of the wires (12), (19), (22), (23) or of the plied wires helically wound round the flat wires, while the width of each flat wire (11), (16), (17), (18), (21) is practically a multiple of said diameter.

9. Stranded conductor of electricity made of copper, aluminium or the alloys of other conducting metals and having a straight core, as in claim 1, characterized in that the flat wires (11), (16), (17), (18), (21) are of equal width and are superimposed on their wider surfaces.

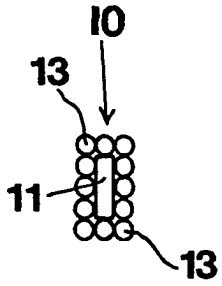

fig.2

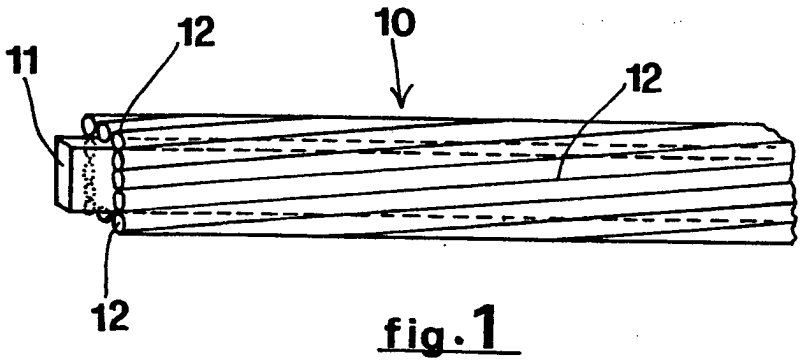

fig.1

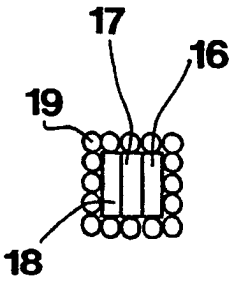

fig.4

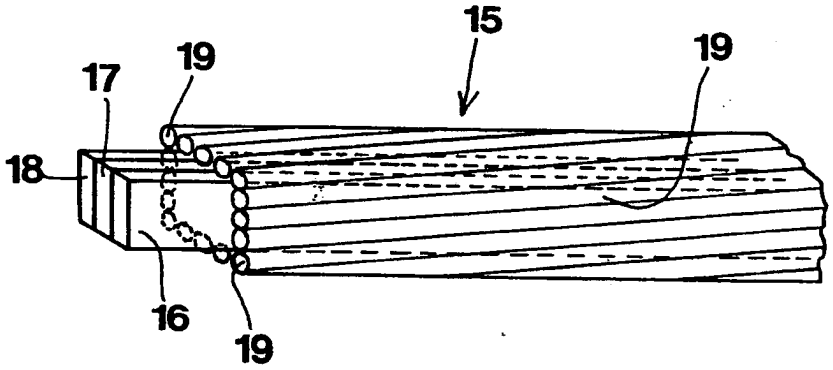

fig.3

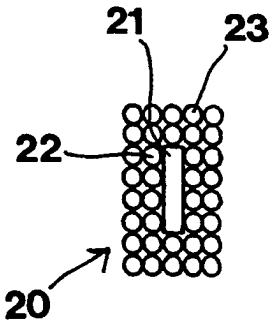

fig.6

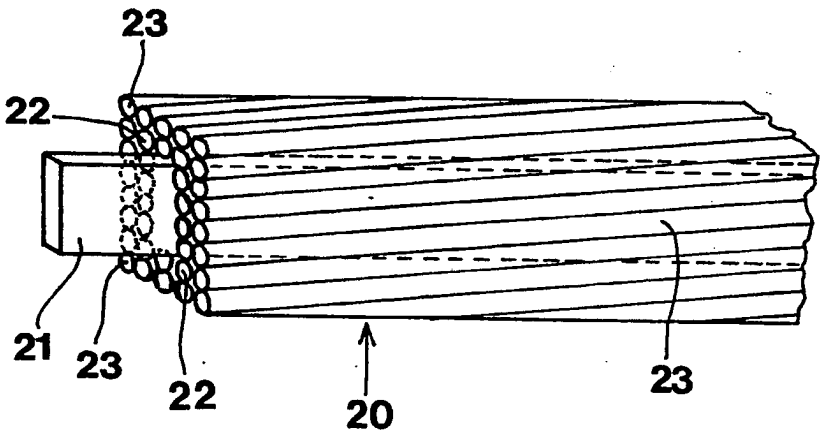

fig.5

INTERNATIONAL SEARCH REPORT

International Application No PCT/IT 89/00043

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H02K3/14 ; H02K3/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	H02K

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	DE,C,312728 (SIEMENS-SCHUCKERTWERKE) 04 June 1919 see page 1, line 1 - page 2, line 7; figures 1, 2.	1-4, 7, 9.
Y	---	6, 8.
X	CH,A,532860 (BROWN BOVERI) 28 February 1973 see column 3, line 40 - column 4, line 11; figures 6-10.	1-5, 7.
Y	---	6.
X	GB,A,14380/1913 (SIEMENS BROTHERS) 26 February 1914 see page 1, lines 16 - 20 see page 2, lines 11 - 17 see page 2, lines 26 - 30; figures 2, 9.	1, 2.
Y	---	8.
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
26 SEPTEMBER 1989	08 NOV 1989
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	DE,A,3241506 (ELEKTROSILA) 10 May 1984 see page 5, lines 17 - 25 see page 7, line 26 - page 8, line 18; figures 1-3.	1-4, 7.
X	DE,C,152107 (PARSONS) 06 June 1904 see page 1, line 1 - page 2, line 63; figures 1-3, 6, 7.	1-4, 8.
X	PATENT ABSTRACTS OF JAPAN vol. 11, no. 306 (E-546)(2753) 06 October 1987, & JP-A-62 100144 (TOSHIBA) 09 May 1987, see the whole document	1-4.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-C-312728		None	
CH-A-532860	15-01-73	None	
DE-A-3241506	10-05-84	None	
DE-C-152107		None	